

is to be expected that it would be set into powerful vibration and give its characteristic spectrum.

In the experiments of Sir William Ramsay and Mr. Soddy 30 milligrammes of radium bromide, probably about four months old, were used. If the α body is helium, the amount of helium liberated by solution of the radium in water must have been between 0.00017 and 0.0017 c.c., assuming that all of the helium produced was occluded in the mass of the substance.

There is evidence of at least five distinct changes occurring in radium, each of which is accompanied by the expulsion of an α particle. One of the products of these changes is the radium emanation. It is of interest to calculate the volume of the emanation occluded in radium when in a state of radio-active equilibrium. Taking as the simplest hypothesis that one α particle is projected at each change, the number of atoms of the emanation produced per second is $1/5$ of the number of α particles, i.e. 1.3×10^{-9} c.c. When radio-active equilibrium is reached, it has been shown that 463,000 times the amount of emanation produced per second is stored up in the radium. This corresponds to 6×10^{-4} c.c. The maximum amount of emanation to be obtained from one gramme of radium thus probably lies between 6×10^{-5} c.c. and 6×10^{-4} c.c.

The radium emanation is the active principle of radium, for about $\frac{1}{3}$ of the activity of radium is due to it. Thus a large proportion of the radiations from radium is a direct result of the changes occurring in the very minute amount of matter constituting the radium emanation. If ever 1 c.c. of the radium emanation can be collected at one spot, it will exhibit some remarkable properties. The powerful radiations from it would heat to a red heat, if they would not melt down, the glass tube which contains it. This very rapid emission of energy, in comparison with the amount of matter producing it, would continue for several days without much change, and would be appreciable after a month's interval. The very penetrating rays from it would light up an X-ray screen brilliantly through a foot of solid iron.

E. RUTHERFORD.

Bettws-y-Coed, August 15.

Summer Lightning.

ALTHOUGH a good deal has been written on the subject of "summer lightning," it may not be superfluous to describe a display of the phenomenon which occurred here last evening on a scale far surpassing anything which it had been my good fortune to witness before. There had been several thunderstorms in the district during the previous five or six days, and a few peals were heard and heavy rain fell in the early afternoon of the day before (August 13). But the sky cleared rapidly thereafter, and the evening and night of that day were cloudless, every peak and crest standing out sharply defined in the clear air. Yesterday was still fine, but warmer and less bracing than visitors here expect. Late in the afternoon wisps of white mist began to gather round the summit of the Jungfrau, and streaks of thin cloud took shape in the higher air above the great mountain ridge that extends from the Silberhorn to the Breithorn. About 8 p.m. I noticed a faint quivering light overhead, supplemented by occasional flashes of greater brilliance and different colour. These manifestations rapidly increased in distinctness, and continued to play only along the opposite mountain-ridge, not extending into the regions beyond, so far as these could be seen from here, though I have since learnt that an independent series of flashes was seen around the Schilthorn on this side of the valley. Not a single peal of thunder was at any time audible. A long bank of cloud formed at a higher level than the summits of the mountain-ridge, and at some distance on the further side of it, so that the stars, elsewhere brilliant, were hidden along the strip of sky above the crest.

As one watched the display it was easy to distinguish more definitely the two kinds of discharge. One of them took the form of a faintly luminous reddish or pink light, which shot with a tremulous streamer-like motion in horizontal beams that proceeded apparently from left to right, as if their starting point lay somewhere about the back of the Jungfrau. These streamers so closely resembled the *aurora borealis* that, had they appeared alone, one would have been inclined to wonder whether the "northern lights" had not here made an incursion into more southern latitudes. So feeble were they when they sped across the clear sky that the stars were clearly visible through them. Sometimes they quivered on the far side of the cloud, lighting up its edges and shooting beyond it across the still unclouded blue. At other times they appeared on this side of the cloud, and showed the dark outline of the mountains in clear relief against the luminous background. They so rapidly succeeded each other that they might be said to be continuous, a faint pinkish luminosity seeming to remain always visible, though pulsating in rapid vibrations of horizontal streamers.

The brighter discharges were not only far more brilliant, but much more momentary. They had a pale bluish-white colour, and came and went with the rapidity of ordinary lightning. But they were clearly connected with the mountains, and not reflections from a series of distant flashes. Sometimes they arose on the other side of the great ridge, allowing its jagged crest to be seen against the illuminated surface of the cloud beyond, but leaving all the precipices and slopes on this side in shade. In other cases they clearly showed themselves on this side of the mountains, lighting up especially the snow-basins and glaciers with the dark crags around them. Nothing of the nature of forked lightning was observed among them. In one instance the flash or horizontal band of vivid light, a mile or two in length, seemed to shoot upward from the slope at the base of the precipices of the Silberhorn, as if it sprang out of the ground, having a sharply defined and brilliant base, rapidly diminishing in intensity upward, and vanishing before reaching half-way up to the crest.

But the most singular feature of the more brilliant white discharges was to be seen when one of the great couloirs of snow or a portion of a glacier remained for a minute or two continuously luminous with a faint bluish-white light. After an interval the same or another portion, perhaps several miles distant, would gleam out in the same way. My first impression was that this radiance could only be a reflection from some illuminated part of the cloud. But I could not satisfy myself of the existence of any continuously bright portions of the cloud. Moreover, the luminosity of the snow and ice remained local and sporadic, as if the beam of a search-light had been directed to one special part of the mountain declivity, and then after a while to another. While watching one of these patches of illumination, I noticed a bright point of light at the top of one of the basins of *nevé* on the slopes of the Mittaghorn. It quickly vanished, but soon reappeared, and then as rapidly was lost again. I thought that it was probably a star briefly exposed through rifts in the cloud, though its position seemed rather below that of the mountain-crest. Half an hour later, however, a similar bright light appeared about the same place, more diffused than the first, and having a somewhat elongated shape. Whether it was really a star seen through the distorting medium of a wreath of mist, or a form of St. Elmo's fire clinging to some peak on the precipice, could not be ascertained from its momentary visibility.

I learnt this morning that other observers who could watch at the same time the mountain ridges on each side of the Lauterbrunnen valley noticed that sheet-lightning was also playing about the Schilthorn, but quite independently of that on the Jungfrau range, the one mountain being dark, while the other was illuminated. The distance of the two electric centres from each other is between five and six miles. The whole display last evening afforded an admirably complete demonstration of the erroneousness of the notion formerly prevalent that summer lightning is only the reflection of distant ordinary lightning, and of the truth of the more recent views as to the nature of the phenomenon.

I may add that, as the lightning increased, the air, which

had previously been nearly calm, freshened into a strong breeze, which blew from the south-west down the valley, but died down after the illumination faded away. The cloud above the mountain began to assume irregular dark cumulus shapes, and the sky became generally overcast. Early this morning rain was falling heavily. The mountains have been all day shrouded in dripping cloud, and the deluge still continues.

ARCH. GEIKIE.

Mürren, August 15.

A Mirage at Putney.

PERHAPS the phenomenon of mirage is not sufficiently rare in England to make its occurrence noteworthy, but I should like to mention a singularly beautiful example that I noticed on Sunday last (August 16). I was riding on my bicycle along the Upper Richmond Road towards the west, and against a fairly steady breeze, and had arrived at that part of the road lying between the railway bridge and the Putney High Street—about opposite house No. 110—when I noticed that the road beyond, some fifty yards in front of me, was apparently flooded ankle deep in water. I was somewhat disconcerted at the prospect of riding through such a quantity of water, but I found to my astonishment that when I arrived at the supposed lake the road was perfectly dry. I thereupon turned and rode back to my previous station, and, dismounting, watched the phenomenon for some while. To assure myself that it was no personal illusion upon my part, I directed the attention of a passing stranger to the scene, and he was impressed as I had been. I should mention that the road sloped slightly downhill from me, and the sun was high (12.50 p.m.) above on my left. The line of sight must therefore have met the dividing surface between the layers of hot and cold air lying above the wooden paving almost at grazing incidence. The surface of the "water" was still, and the reflection of the gay dresses and sunshades of the ladies just from church was remarkably and beautifully clear.

H. E. WIMPERIS.

London, S.W., August 17.

THE SOUTHPORT MEETING OF THE BRITISH ASSOCIATION. SECTIONAL ARRANGEMENTS.

THE arrangements of the various sections of the British Association for the forthcoming meeting at Southport have now been practically completed. The following summary shows the chief points of the programmes, so far as they are at present known:—

Mathematical and Physical Sciences.—The physical portion of Section A will be mainly occupied in discussing three questions of considerable interest to physicists at the present time. The nature of the emanations from radio-active substances will be introduced as one of the subjects for discussion by Prof. Rutherford, of Montreal, and it is expected that several visitors from the Continent will take part. Mr. Swinburne will introduce a discussion of the method of treatment of non-reversible processes in thermodynamics, in which Prof. Perry and others will have something to say, and Prof. Henrici will direct attention to the desirability of introducing vectorial methods into physics to a much larger extent than has been done hitherto. The fact that the International Meteorological Congress meets at Southport under the presidency of Prof. Mascart, of Paris, at the same time as the Association, will make the work in the department of Section A devoted to meteorology and astronomy of special importance this year. Contributions to the proceedings of the department have been promised by several of the members of the congress, including Hildebrandsson, Paulsen, and Pernter, and Sir Norman Lockyer will discuss the agreement in time between certain solar and terrestrial phenomena. Papers have been promised by Prof. Turner, Dr. W. J. S. Lockyer, the Rev. A. L. Cortie and Mr. Hinks, and there will be an exhibition of photographs from the Yerkes Observatory.

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Chemistry.—In his opening address to the section, the president, Prof. W. N. Hartley, F.R.S., proposes to give a brief account of twenty-five years' work in spectroscopy applied to the investigation of the composition and constitution of terrestrial substances, both organic and inorganic, and to review the present position of spectroscopy chiefly in relation to chemical theories, indicating where it may be usefully and profitably extended. The following papers will be read:—"Dynamic Isomerism," by Dr. T. M. Lowry; "Hydroaromatic Compounds," by Dr. A. W. Crossley; "The Cause of the Lustre produced during the Mercerising of Cotton," by Mr. J. Hübner and Prof. W. J. Pope, F.R.S.; "Mutirotaion, and the Glucoside Formula of Glucose," by Dr. E. F. Armstrong; "A Contribution to the Constitution of the Disaccharides," by Mr. T. Purdie, F.R.S., and Dr. J. C. Irvine; "Some Derivatives of Fluorine," by Miss Ida Smedley; "Fluorescence as Related to the Constitution of Organic Substances," by Dr. J. T. Hewitt; "The Cholesterol Group," by Dr. R. H. Pickard; "On Essential Oils," by Dr. O. Silberrad; "Freezing Point Curves of Binary Compounds," by Dr. J. C. Philip; "Action of Diastase on the Starch Granules of Raw and Malted Barley," by Mr. A. R. Ling; "Action of Malt Diastase on Potato Starch Paste," part i., by Mr. B. F. Davis and Mr. A. R. Ling; "Action of Malt Diastase on Potato Starch Paste," part ii., by Mr. A. R. Ling; "Some Properties of Sodium Hydride," by Mr. A. Holt; "On a Method of Separating Cobalt and Nickel and the Volumetric Determination of Cobalt," by Mr. R. L. Taylor; "The Influence of Small Quantities of Water in bringing about Chemical Reaction between Salts," by Dr. E. P. Perman; "Sur le Spectre du Silicium" and "Sur les Procédés de Photographie Spectrales applicables à la Pratique des Laboratoires de Chimie," by M. le Comte Arnaud de Gramont. Dr. W. A. Bone will open a discussion on the general subject of combustion by a paper on the combustion of methane and ethane.

Geology.—The following papers have been promised in this section:—"On the Disturbance of Junction-beds from Differential Shrinkage during Consolidation," by Mr. G. W. Lamplugh; "On the Igneous Rocks of Weston-super-Mare," by Mr. William Boulton; "On the Igneous Rocks of the Berwyn Mountain," by Mr. T. H. Cope and Mr. J. Lomas; "On the Recent Work of the Geological Survey," by Dr. J. J. H. Teall, F.R.S.; "Lower Ordovician Rocks in the Neighbourhood of Snowdon and Llanberis," by Mr. W. G. Fernsides; (1) "On the Origin of Certain Quartz Dykes at Foxdale, Isle of Man," (2) "On some Glacial Lakes in Switzerland," (3) "On the Geology of the Country Around Southport," by Mr. J. Lomas; "On the Porosity of Rocks," by Mr. C. C. Moore; "Notes on Sarsen Stones, with Special Reference to the Stones at Stonehenge," by Mr. H. W. Monckton; "On the Geology of Martin Mere," by Mr. H. Brodrick; (1) "On the Origin of Eruptive Rocks," (2) Observations on the Metalliferous Deposits of the South of Scotland," by Mr. J. G. Goodchild; (1) "On the Origin of the Drift Deposits of Lancashire and Cheshire," (2) "On the Striation of Boulders on Modern Beaches," (3) "Observations upon the Evidences for the Former Existence of Glacier-Lakes in N. England and S. Scotland," by Mr. P. F. Kendall. Dr. A. Smith Woodward, F.R.S., has promised a paper, but the title is not yet known. There will also be the first report of the committee appointed at Belfast to report upon the fauna and flora of the Trias of the British Isles. The greater part of this first report is furnished by Mr. Beasley, and deals with footprints.